

Regional Environmental Planning Program

December 1998

Berkshire-Tunbridge-Lyman: very deep, moderately deep, and shallow, gently sloping to very steep, well drained and somewhat excessively drained, loamy soils that formed in glacial till. **Barnardston-Cardigan-Keasarge-Dutchess:** very deep, moderately deep and shallow, gently sloping to very steep, well drained and somewhat excessively drained, loamy soils that formed in glacial till. **Caesar-Windsor:** very deep nearly level to very steep, excessively well drained sandy soils that formed in glacial outwash deposits. **Cotton-Adams:** very deep, nearly level to very steep, excessively drained soils that formed in glacial outwash deposits. **Cotton-Adams-Lainout:** very deep, nearly level to very steep, excessively drained, somewhat poorly drained, and poorly drained, sandy soils; on outwash plains and terraces. **Marlow-Berkshire-Tunbridge:** very deep and moderately deep, gently sloping to very steep, well drained; loamy soils that formed in glacial till. **Marlow-Peter:** very deep, nearly level to steep, well drained and moderately well drained, compact, loamy soils; on uplands. **Monadnock-Lyme:** very deep nearly level to steep, well drained and poorly drained, loamy soils; on uplands. **Monadnock-Lyman-Tunbridge:** very deep to shallow, gently sloping to steep, well drained and somewhat excessively drained, loamy soils; on uplands. **Monadnock-Tunbridge:** very deep and moderately deep, gently sloping to very steep, well drained, loamy soils that formed in glacial till. **Raynham-Ossipee-Rippowam:** very deep, nearly level, poorly drained and very poorly drained, heavy and medium textured, formed in lake deposits, organic deposits and alluvial deposits. **Windsor-Agawam-Hoosie:** very deep, nearly level to very steep, excessively drained, well drained, and somewhat excessively drained, sandy and loamy soils that formed in glacial outwash deposits.



SWRPC

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Statement of Purpose

The mission of the Southwest Region Planning Commission is to “*Work in partnership with the communities of the Southwest Region to promote sound decision-making for the conservation and effective management of natural, cultural and economic resources*”. Direct assistance to local officials in municipal governance, community planning, land use regulation, and community development is a fundamental part of the Commission’s work program to enact the mission. Regional planning activities arise both *ad hoc* from subregional intermunicipal interests and programatically from within state agencies with purviews in resource and infrastructure management.

There are many ways to characterize the purposes of planning, such as social and natural resource conservation, managing competition for land and public trust resources, working to segregate incompatible land uses, promoting the best use of private land and community resources, and ultimately protecting the health, safety and general welfare of the public. Local and regional planning has many facets among which a myriad of relationships must be understood. The suitability of land areas for kinds of land uses should be a basic element of land owners’, municipalities’ or regions’ planning.

The Southwest Region landscape is largely undeveloped. Residential, commercial, industrial, and institutional land use tends to be concentrated in established population centers which have grown from 19th-Century industrial sites on the Region’s rivers, especially the Ashuelot and Contoocook. The mixed-use centers account for less than 10% of the Region’s land area. Residential development also occurs distributed across the landscape with trends for concentration along state and local roads and the fairly level, generally hospitable terrain of valley floors and rolling hilltops (formerly farm land). Again, rural residential land use accounts for less than 10% of the land area. More than 80% of the Southwest Region is undeveloped and the majority of that is forested upland. Figure 1. on the following page is a map depicting the extent of development in 13 towns central to the Southwest Region. The map uses data from the NH GRANIT GIS data base: LANDSAT TM Land Cover.

Constant demand for enhanced conservation efforts and economic expansion¹ co-exist in open public dialogue and the activity of private organizations representing conservation and business and of course, private individual activities in land/resource management, real estate transactions and business management. Competition between conflicting agendas intensifies as communities and groups feel that a critical threshold is approached or exceeded in the balance of land uses, a balance which creates the prevailing character of a town or region. There is also intensified interest in the protection of ecological integrity in the contexts of both the philosophy for protection of biodiversity and more pragmatic social interests such as water supply and affordable waste water treatment options. The intensification of competition is bringing greater scrutiny and publicity to public and private land use decisions. Within the Commission’s purview there is a growing demand for defensible, accurate and accessible information (and analysis) by which to qualify the appropriateness of public decisions regarding zoning, public spending for conservation, issuance of environmental permits and community goals, in general.

¹ Economic expansion is frequently synonymous with conversion of land (undeveloped and developed) to more intensified uses, manifested as a trend of suburbanization and urbanization. Increased demand for public infrastructure, including centralized water supply and waste management is one typical effect of urbanization.

The information about the landscape available in the USDA soil survey provides an excellent reconnaissance tool for inquiry into land potential relative to different kinds and intensities of land uses and development.

The growing demand for information assistance is also in part due to a general awareness of the 1) availability and cost effectiveness of USDA soils data in the Commission's Geographic Information System (GIS) and 2) availability and cost effectiveness the Commission's GIS information management and analysis capabilities. GIS is a powerful tool for describing not only the location and condition of single or multiple variables, but also the interaction of multiple variables, including interaction between social and physical variables.

This project initiates an enhanced GIS data base comprising USDA soil survey data and enhanced analytical capabilities within the Commission for application in local and regional planning, particularly regarding land use decisions, conservation/environmental planning, and zoning to implement community development goals.

This report may serve as an overview for local officials, development interests, public resource agencies and private conservation interests regarding the nature of soils-based limitations to development in the Southwest Region.

Products and outcomes of this first-year project include:

- enhanced regional soils data base;
- report on the findings of preliminary analysis of soil-based limitations to development in the Southwest Region;
- availability of findings of the preliminary analysis on regional, sub-regional, town, watershed, or any other spatial delineation; and
- development of institutional capacity at the Commission regarding knowledge of soils information, Natural Resources Conservation Service (NRCS) soils interpretations, and implementation of analytical methodologies (including establishing new working relationship between the Commission and NRCS state-level soil scientists and GIS technicians).

Approach

Information on soil conditions and other landscape variables known to impose limitations on development as reported by the USDA Natural Resources Conservation Service (NRCS, formerly the Soil Conservation Service) 1984 Soil Surveys for Cheshire County and 1984 Soil Survey for Western Hillsborough County was analyzed for the study area using ArcInfo™ Geographic Information System. Soil conditions as used here may serve as indicators of need for environmental protection or opportunity for development - also variously referred to as indicators of suitability or favorability for development.

The development activities chosen for analysis are Building Site development, woodland Management (for timber production) and on-site subsurface sewer system (leach field or absorption field) installation. Analysis began with the NRCS tables found in the 1984 Soil Surveys which qualify soils for limitations to "Building Site Development," "Woodland Management" and "Sanitary Facilities," (Figure 2.).

Figure 2. Explanation of NRCS Soil Survey Tables

Building Site Development

Soil	Shallow Excavation	Dwellings without Basements	Dwellings with Basements	Small Commercial Buildings	Local Roads and Streets	Lawns and Landscaping
76B Marlow	Moderate: dense layer	Slight	Moderate: wetness	Moderate: slope	Moderate: frost action	Slight

Sample entry from table 10. Cheshire Co.

NRCS Survey Soil Unit Code and Name. The Unit Code indicates the type of Soil by number (76). There are 264 different soil types in the Corridor. The Code also indicates the slope of land by letter, generally as: A= 0-5%, B= 5-8%, C=8-15%, D=15-25%, E > 25%.

Slight = generally favorable to development; Moderate = some special considerations may be required to overcome limitations; Severe = substantial costs and other special considerations may be required to overcome limitations of soil conditions or site features

These descriptors of soil or site limitations were not used in this analysis.

Woodland Management

Soil	Erosion Hazard	Equipment Limitations	Seedling Mortality	Windthrow Hazard	Plant Competition
75B Marlow	Slight	Slight	Slight	Moderate	Moderate

Sample entry from table 7. Cheshire Co.

NOTE: Table 7. Woodland Management and Productivity appearing in the Soil Survey contains fields not shown or used here: Ordination Symbol, Common Trees, Site Index, Productivity Class, and Trees to Plant.

Sanitary Facilities

Soil	Septic tank absorption field	Sewage lagoon areas
76B Marlow	Severe: percs slowly	Moderate: seepage, slope

Sample entry from table 11. Cheshire Co.

Suitability for lagoons was not used in this analysis.

A score was calculated for each soil unit for each of the three variables: Building Site Development, Sanitary Facilities, and Woodland Management:

1. Scores were calculated by assigning numeric values to the NRCS qualifiers “slight”, “moderate”, and “severe” (Table 1.).

Table 1. Numeric Values Assigned to NRCS Qualifiers

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Variable	Qualifier	Score
Building Site Development	Slight	5.55556
	Moderate	11.11111
	Severe	16.66667
Woodland Management	Slight	0
	Moderate	8
	Severe	16
Sanitary Facilities *	Slight	0
	Moderate	50
	Severe	100

* Soils are qualified for only one variable: "septic tank absorption field".

2. Cumulative scores were calculated for each soil type within each table.
3. Cumulative scores for each soil type within each variable were reclassified as slight, moderate or severe using a natural groupings algorithm for each variable.

The NRCS qualifiers "slight," "moderate," and "severe" indicate a level of effort required on the part of the land owner or developer to accomplish the specified activity, such as site development, timber harvest, or installation of a septic absorption field. That effort may be required during or after construction and may include special considerations in engineering, construction, or maintenance and almost always indicate additional financial cost. These qualifiers may also provide an indication of the level of risk of environmental damage, including loss of soil potential, loss of soil, and contamination of ground or surface waters, as a result of a specified activity. The qualification of a soil unit as having slight limitations to building site development does not free a developer from soil erosion control practices before or after construction and likewise a severe limitation does not mean that construction there is not possible, only that special considerations or precautions will be necessary. The qualifiers may be interpreted as indicators of favorability or suitability. The Commission worked with the NRCS statewide soils data base, data dictionary and interpretive documentation.

Building Site Development, Woodland Management and Sanitary Facilities were chosen for analysis from the suite of NRCS tables due to the domination of development, conservation and land use policy- and decisions-making in public forums in the Southwest Region. This project does not intend to promote the reliance on this exploratory analysis of these several variables in isolation from the remainder of data provided by the NRCS for land use policy and decisions. But, again it is a purpose of this project to elevate physical environmental considerations to a status in those forums that is equal the impact of with socioeconomic variables such as access to public roads and prevailing economic trends on policy, regulation, and land use decisions.

Tables 2., 3., and 4. below present examples of the application of the numeric methodology to illustrate range of scoring outcomes. Three different numeric schemes were used to test the utility of each regarding the definition of breaks between groups as slight, moderate or severe.

Table 2. Building Site Development

Scoring used units of 5.55556 to allow a total possible score of 100 under the six types of development from the USDA Soil Survey, where slight = 5.55556; moderate = 11.1111; and severe = 16.66667

Soil Unit	excavations	house w/o basement	house w/ basement	commercial building	local roads	landscaping	Cumulative Score
76B	11.11111	5.55556	11.11111	11.11111	11.11111	5.55556	56
76C	11.11111	11.11111	11.11111	16.66667	11.11111	11.11111	72
76D	16.66667	16.66667	16.66667	16.66667	16.66667	16.66667	100
526A	16.66667	5.55556	5.55556	5.55556	5.55556	16.66667	56
526B	16.66667	5.55556	5.55556	11.11111	5.55556	16.66667	61
526C	16.66667	11.11111	11.11111	16.66667	11.11111	16.66667	83
526E	16.66667	16.66667	16.66667	16.66667	16.66667	16.66667	100

In these sample Soil Units limitations principally arise from the steepness of slope.

Table 3. Woodland Management

Scoring used units of 8 to allow a total possible score of 100 under the five timber management considerations from the USDA Soil Survey, where slight = 0; moderate = 8; severe = 16; and erosion is weighted by 2 to reflect the high priority given erosion under USDA interpretations.						
Soil Unit	erosion	equipment operation	seedling mortality	windthrow hazard	plant competition	Cumulative Score
76B	0	0	0	8	8	16
76C	0	0	0	8	8	16
76D	8	8	0	8	8	40
526A	0	0	8	0	0	8
526B	0	0	8	0	0	8
526C	0	0	8	0	0	8
526E	8	8	8	0	0	32

In these sample Soil Units limitations arise from the steepness of slope and soil textures.

Table 4. Sanitary Facilities (Absorption Fields)

Soil units evaluated in units of 50 to allow a total possible score of 100 under this single criterion from the USDA Soil Survey, where slight = 0; moderate = 50; and severe = 100.			
Soil Unit	Score	Limitation	
76B	100	percs slowly	
76C	100	percs slowly	
76D	100	percs slowly; slope	
143A	50	slope	
143B	0	- na -	
143C	50	slope	
143D	100	slope	

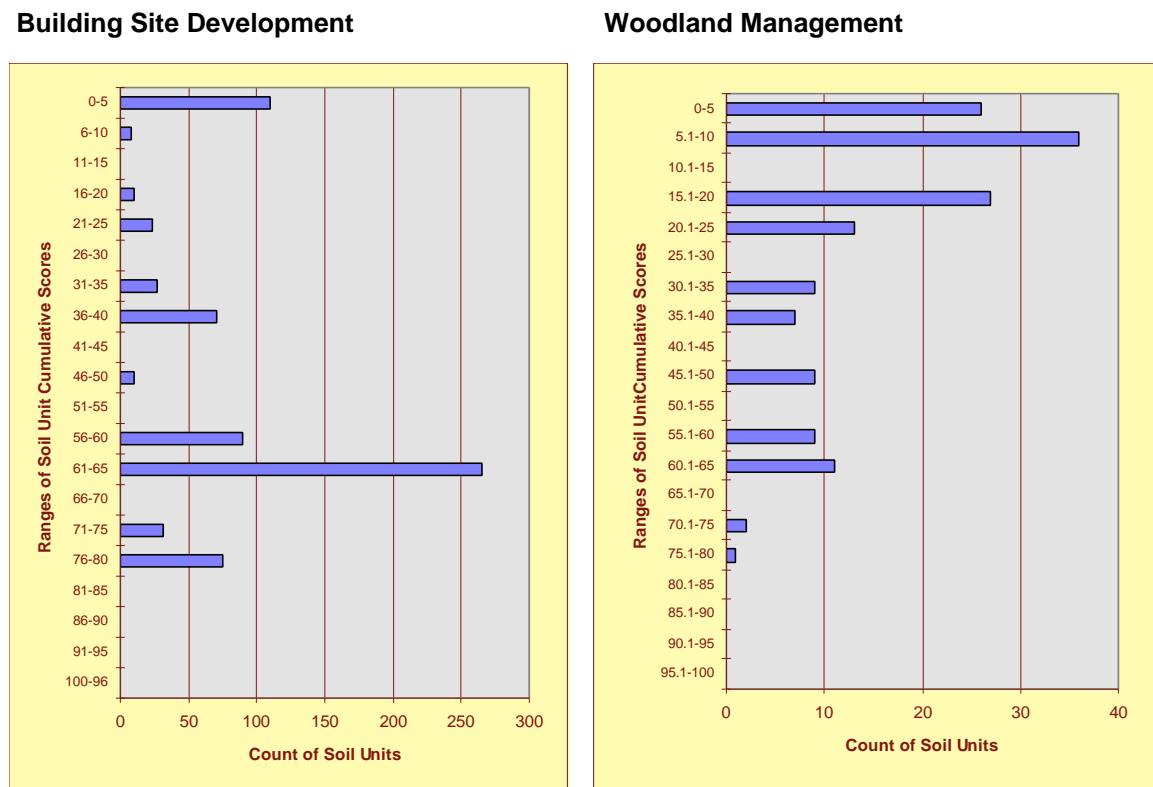
Findings

Maps depicting the distribution of the derived classes were also prepared on a regional scale. The maps “ Southwest Region Soil Limitations for Building Site development”, “Southwest Region

Soil Limitations for Woodland Management”, and “Southwest Region Soil Limitations for Septic Tank Absorption Fields” are enclosed with this report.

Figure 3. presents the distribution of soil units across the cumulative score ranges for Building Site Development and Woodland Management.

Figure 3. Distribution of Soil Units by Cumulative Scores



Tables 5., 6., and 7. present acreage and percent of land area with the Southwest Region by limitation class for the test activities.

Table 5. Building Site Development

Classification	Range (Weighted Totals)	Cheshire		Hillsborough		Southwest Region	
Slight	0-50	30,711	7%	12,590	7%	43,301	5%
Moderate	51-65	31,146	7%	31,158	18%	67,305	8%
Severe	66-100	390,562	86%	129,997	75%	520,559	82%

Table 6. Woodland Management

Classification	Range	Cheshire		Hillsborough		Southwest Region	

	(Weighted Totals)						
Slight	0-20	195,726	44%	97,130	56%	292,856	47%
Moderate	21-60	180,433	41%	70,925	41%	251,358	41%
Severe	61-100	67,722	15%	6,707	4%	74,429	12%

Table 7. Sanitary Facilities (Absorption Fields)

Classification	Range (Weighted Totals)	Cheshire		Hillsborough		Southwest Region	
Slight	0	11,345	3%	3,427	2%	14,772	2%
Moderate	50	37,818	8%	11,265	7%	49,133	8%
Severe	100	403,256	89%	142,378	91%	545,734	90%

The most conspicuous regional trends from Tables 5., 6. and 7. is the apparent suitability for timber production and general unsuitability for development. This may appear to jeopardize the value of this analysis in that new homes with septic systems continue appear by the hundreds throughout the Region each year. But, again, USDA indications of limitations refer to the level of effort required to overcome limitations. Continued growth in the face of such widespread limitations may indicate a number of conditions, such as a willingness and ability (financial resources) of developers and land owners to undertake the measures necessary to pursue their development goals; other socioeconomic attractants outweigh cost of development; or that Southwest Region soil conditions are not unlike those in the greater region. The nature of compensatory actions must also be considered. For example, most of the Southwest Region soils impose severe limitations to absorption field installation and operation, however, several truck loads of sand typically remedy that limitation - a cost easily borne by most home builders and buyers. The best use of this analysis may be to target areas best suited for suburban or urban land use patterns, rather than attempting generalizations about development limitations.

The analysis presented here at the regional scale is divisible to any sub-regional delimitation desired, acknowledging the 4-acre inclusion limitation of the Soil Surveys.

Future Activity

This project has generated an interest among Commission and NRCS staff to revisit the soil potential index ratings developed in the early 1980's for Cheshire and Hillsborough Counties. Currently, the two agencies are exploring a mutual proposal for cooperation with NRCS state soils science and GIS staff for application of GIS "fuzzy logic" methodologies for advanced multivariate analysis of interaction between variables which can create soil conditions unique to areas within counties. Further GIS soil data base development may also lead to the application of the USDA Forest Land Evaluation and Site Assessment (FLESA) protocol to areas within the Southwest Region.